

The VLF-3 Receiver and VLF Listening in General

Notes and Comments

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Many have worked long and hard on the design of a new VLF receiver for the INSPIRE project. Foremost would be John Kohus (the kit designer), along with Bill Taylor and Bill Pine. I was fortunate (along with several other INSPIRE participants, in particular Bob Bennett) to be part of the design and testing phase of the VLF-3 receiver.

In designing the new receiver, we have attempted to take every type of user into consideration. Due to the simple fact that INSPIRE receivers are most commonly used with short, vertical E-field antennas, we decided that the sensitivity of the new receiver could be improved for this type of user.

Several improvements have been introduced to the front-end circuitry to eliminate as much of the unwanted thermal noise as possible and to greatly improve performance and sensitivity to natural VLF radio signals. These changes will easily allow activity to be monitored that was not capable of being received on previous INSPIRE receivers with the same antenna.

The increased sensitivity of the VLF-3 receiver may make it slightly more prone to overload and out of band interference for long wire antenna users. For this reason, we have selected to also include a new feature on the VLF-3 receiver. This new feature is a simple filter which can be engaged or disengaged by the flip of a switch. If overload or interference is experienced, a person has simply to flip on the filter to eliminate it!

While on the discussion of antenna types, this is a good time to discuss the two main types of E-field antennas. The first type of antenna is the short, vertical whip antenna (generally 1-3 meters in length). The second type of antenna is the long wire antenna.

Over the course of the past several years, I have spent a considerable amount of time listening to VLF and testing different antenna types. I have used everything from a 1500' long wire antenna atop a 12,000' mountain, to a 100' vertical antenna lifted by a helium balloon, to a couple of simple 8' antennas on the prairies of northeastern Colorado.

What I have discovered over this course of time is that a simple 8' vertical antenna can work just as well as a long wire antenna when a receiver is designed to be extra sensitive! This was the plan and purpose for designing the VLF-3 receiver with greatly improved sensitivity.

What comes to mind when you visualize a “long wire antenna?” All too often, the imagination visualizes a long wire laid horizontally along the ground or slightly above the ground, or perhaps a long wire strung across the tops of short trees or bushes. Rarely if ever does the thought of a long wire antenna trigger the thought of a “vertical” antenna stretching toward the sky. I bring this up for one simple reason and that is the fact that long wire “vertical” antennas provide much greater signal strength over the conventional long wire “horizontal” antennas.

In fact, I have found that a 50’ long wire “vertical” antenna provides about the same amount of signal as a 1000’ long wire “horizontal” antenna. A simple 8’ “vertical” antenna provides about the same amount of signal as does a 100’ “horizontal” antenna.

When it comes to antenna length, after all experiments have been done, I have come to the simple conclusion that the longest antenna, either vertical or horizontal, that a person needs on a VLF receiver is the one that is just long enough to provide the cleanest sounding signal without overloading the receiver with unwanted interference. For long wire antenna users, this may mean either lengthening or shortening the antenna to achieve the best possible reception.

On very sensitive receivers (such as the VLF-3), a shorter antenna will accomplish what only a longer antenna would be capable of accomplishing on less sensitive VLF receivers. This brings to light the fact that the more sensitive a person can make a receiver, the less antenna length will be required to hear the same great activity! Down this same line of thought, the worst VLF receiver that comes to mind would likely be an ordinary speaker from a home stereo system. A simple 8-ohm speaker would require hundreds of miles of wire to begin to receive the signals that can easily be monitored on the VLF-3 receiver with just a simple, short vertical antenna. Whistlers were actually first heard on telegraph lines without amplification! In summary, the least sensitive receivers will require the longest antenna lengths and the most sensitive receivers will require the shortest antenna lengths to accomplish the same results.

When it comes to which antenna receives the least amount of power line interference, I have yet to fully answer this question in my own mind. This will be at least somewhat dependent upon the particular recording location and antenna orientation. A long wire horizontal antenna should be laid out so as to minimize power line interference. This will require running the antenna perpendicular (instead of parallel) to the nearest power lines. The wave electric field of the power line interference will be parallel to the power line, so orienting the antenna perpendicular will induce the smallest amount of signal into the antenna.

Vertical antennas are perpendicular to the electric field of power line interference, since power lines are primarily horizontal. This should theoretically help prevent vertical antennas from receiving power line interference and may also give them the leading edge over long wire horizontal antennas, at least when it comes to receiving the least amount of power line interference.

I personally have chosen to use either two or four 8’ vertical whip antennas (electrically tied together) when I monitor VLF activity. I have found this type of setup to be the simplest and

best system overall for monitoring VLF. My setup utilizes two 8' antennas mounted on the rear bumper of my car and the capability of adding two additional 8' antennas on the front bumper of my car when deemed necessary. Why four antennas? One antenna works great, but two work better. And again, two work great, but four work even better. Beyond four 8' vertical antennas, I did not notice anything in the way of improvement to natural VLF signal strengths. The only thing that was improving beyond four 8' antennas was interference!

The increased sensitivity of the VLF-3 receiver will allow it to receive everything with greater strength. This will include whistlers, chorus, tweeks, sferics and, yes, power lines, too!

While trying the new VLF-3 receiver for the first time, try this simple test. Switch the filter off and on. This will not only turn the filter off and on but it will also give a rough idea between the difference in receiving capabilities between the VLF-2/RS-4 receivers (filter on) and the VLF-3 receiver (filter off). I'm sure everyone will easily notice the great improvement in sensitivity that the VLF-3 receiver has to offer. This will especially apply to short, vertical antenna users! From the above experiment, it will be noticed that what is really occurring is that a lot of the remaining noise (what is termed "thermal noise" in electronic design) is being eliminated from the VLF signal. By eliminating this noise, a lot more signal will be received in the way of fascinating VLF activity!

Another point of interest to many VLF listeners is the selection of a listening location. Here are three points to keep in mind when choosing a listening location for E-field receivers such as the VLF-3 receiver: 1.) Try to locate a listening spot as far as possible from power lines. (This will not only reduce the amount of power line interference received but will also increase reception of weak natural VLF signals). 2.) Try to select a site that is as high as possible above the surrounding terrain. An example may be the top of a tall hill or a mountain top. 3.) And finally, try to avoid setting up a listening site near trees, buildings, other nearby structures or busy roadways. These will all reduce the reception of natural VLF signals.

The VLF-3 receiver is truly an amazing piece of electronic design. It has been the goal of all connected with designing the latest INSPIRE receiver to make a receiver that would clearly outperform previous receivers and one that would also be very versatile for users of both short whip antennas and long wire antennas.

Enjoy!